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The Effect of Cleaning on the Grade, Staple and Price of Cotton

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Digest

The removal of all foreign matter from ginned cotton should raise the grade, qualifying it for a higher price. The extent of the changes produced by cleaning with a Shirley analyzer was determined for 132 cottons representing 31 varieties and strains, 5 locations and 4 methods of harvesting. Two classers classed each cotton before and after cleaning, using the usual classifications for grade and staple. Price differences were calculated at prevailing prices for normal ginned cotton.

Cleaning improved the average grade 2 grades according to one classer and 4 grades according to the other classer. Cleaning had no significant effect on staple.

Changes in price due to cleaning, calculated for grades and prices of normal ginned cotton, ranged from a loss of $21 to a gain of $49 with average gains of $6 and $10 per bale for the two classers.

The classers differed an average of 0.3 grade for uncleaned and 2.2 grades for cleaned samples. Differences between classers were 2 or more grades for 34 uncleaned and for 82 cleaned samples. In staple they differed approximately 3/32 inch for uncleaned and 2/32 inch for cleaned samples. These differences are evidence that classers do not adhere to the same degree to standards for grades and that estimates of length are not always reliable.

Prices received by growers are based on government standards for grade. The standards used by individual firms and classers frequently are modifications of government standards. This practice of using different standards, plus inevitable human errors, may add up to material losses to the growers. Government grade is the chief determinant of price, therefore, it is tremendously important that each and every sample is graded as close to actual government grade as is humanly possible. Frequent use of the physical measurements now available should help reduce the differences between classers.

From this study, it is concluded that, at present classifications and prices, it probably would not be profitable to remove all foreign matter from cotton containing less than approximately 6 percent.

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The Effect of Cleaning on the Grade, Staple and Price of Cotton

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ALL COMMERCIAL RAW COTTON contains some foreign matter. This foreign matter largely determines the grade, which, with the length, determines the price. The kind and quantity of foreign matter are, therefore, of great importance not only to the grower and the cotton buyer but to all those who use products made from cotton.

The grower is constantly urged to harvest his cotton as clean as possible so that he may receive a high price per pound.

Normally, hand-picked cotton contains the least foreign matter followed by machine-picked, snapped and machine-stripped. The greatest difference in amounts of foreign matter is usually found between hand-picked and each of the other methods.

More and better mechanical harvesting is largely responsible for the development of superior cleaning equipment, which, with improvements in ginning equipment, are turning out cleaner cotton.

The questions arise as to what extent additional time, labor and machinery are justified by the higher price paid for the cleaner cotton, and to what extent our present method of classing cotton is satisfactory for clean cottons. This study was undertaken with the hope of answering some of these questions.

Preliminary Work

It was found in a preliminary study[1] that the removal, with a Shirley analyzer[2], of all foreign matter from 60 cottons raised the grade, according to a board of cotton examiners, an average of 4.2 grades. Improvement in grade due to cleaning resulted in changes in price from a loss of approximately $14 to a gain of $24 per bale, a range of $38. The average gain was $7 per bale.

[1]The Effect of Foreign Matter on the Grade, Staple and Price of Cotton, by Mary Anna Grimes. 1945. Texas Agricultural Experiment Station Progress Report 954.

[2]The Shirley Analyzer, by George Pfeiffenberger. Textile Research, 1944, Vol. XIV, No. 2, pages 50-54.

When classed by a second classer, the averages were approximately the same, although there were frequently wide differences between the classers in their estimation of the effect of cleaning on the grade and staple of individual cottons.

Methods of Study

To check the conclusions drawn from the preliminary work, the study was continued with 132 additional cottons which were cleaned with the Shirley analyzer and classed both in the uncleaned and cleaned states by 2 classers.

The Shirley analyzer removes practically all foreign matter plus some short or broken fibers from the ginned cotton. This material is hereafter frequently called waste.

The 132 cottons came from 5 locations in Brazos, Burleson and Lubbock counties. They included 31 varieties and strains and 4 methods of harvesting. In some cases the samples represented different harvesting dates from the same location. Most of the samples were ginned on commercial gins.

The classers were told that the cleaned samples were the same cottons as the uncleaned but with the foreign matter removed. The samples were so numbered that pairing of uncleaned with cleaned samples was impossible, except by chance. The classers were asked to give separate grades for leaf, color and preparation, which are factors comprising grade, and a composite grade for each sample. In most cases the preparation for the uncleaned samples was said by the classers to be "normal" and no grade given for preparation. Since the preparation of the cleaned samples was not "normal," no grade was given for preparation. For both the uncleaned and cleaned, 3 grades were given for each sample—leaf, color and the composite grade. The classer's estimate of staple was given for each sample.

As is routine procedure when cotton classing is requested, each classer was sent duplicate samples of uncleaned cottons to see how closely each checked with his own classing.

Prices used for both uncleaned and cleaned cotton are those for spot cotton for delivery March 1, 1948. Staple premiums and discounts are averages for lengths quoted in New Orleans, Galveston, Houston, Dallas, Memphis and Little Rock. Differences for grade are the averages of the first 5 of these 6 markets.

Since in several cases the classers differed widely, the classification given by each classer is shown. The report is, therefore, divided into three sections, one for each classification and a third for a discussion of the results.

Waste Removed from Cotton

The Shirley analyzer removes practically all visible foreign matter and small amount of short or broken fibers. There are

only occasional bits of foreign matter visible after the lint has twice passed through this cleaning device. The cleaned samples, for which the classer was asked to assign grade and staple, were almost completely devoid of foreign matter.

The waste removed by the Shirley analyzer from the 132 cottons ranged from 3.8 to 23.3 percent by weight. The lowest average waste was in the hand-picked cotton followed in order by machine-picked, hand-snapped and machine-stripped (Table 1). For the 59 hand-picked cottons, the range in waste was from 3.8 to 9.8 percent. The waste in the 27 hand-snapped ranged from 5.1 to 16.0 percent. The 37 machine-stripped ranged from 4.2 to 23.2 percent. For the 9 machine-picked cottons, the range in waste was the narrowest of the 4 methods, 7.1 to 9.7 percent.

Report for Classer A

Uncleaned Cotton

The effects of cleaning on the grade, staple and price of the cottons, based on the classifications of classer A, are given in Tables 1 to 5.

Grouped by method of harvesting, the averages of waste, and the grades and staples for the uncleaned and cleaned samples are shown in Table 1.

The average composite grade for the 132 uncleaned samples was grade 6.6, or approximately LM+. There was a range from grade 5(M) to grade 8(SGO). The hand-picked was given the highest average composite grade, 6.2, followed by snapped, 6.7, machine-picked, 6.9, and stripped, 7.1 (Table 1). There were differences of 0.5, 0.7 and 0.9 grades between hand-picked and each of the other 3 methods of harvesting.

The hand-picked cottons with the least waste, 5.9 percent, were classed 6.2 (SLM), and the machine-stripped with the

Table 1. The average waste, grade and staple of uncleaned and cleaned cotton*

Method of harvesting	No. of cottons	Uncleaned					Cleaned				
		Waste, %	Grade			Staple, 32nd inch	Grade			Staple, 32nd inch
			Leaf	Color	Composite		Leaf	Color	Composite	
Hand-picked	59	5.9	6.0	6.0	6.2(SLM)	27.7	3.1	4.6	4.2(SM)	27.9
Machine-picked	9	8.6	6.9	6.8	6.9(LM)	28.1	3.3	5.2	4.6(M+)	28.1
Hand-snapped	27	9.4	7.0	6.3	6.7(LM+)	27.0	3.3	4.9	4.5(M+)	27.4
Machine-stripped	37	10.5	7.1	6.7	7.1(LM)	25.0	3.5	5.5	5.0(M)	26.7
Average		8.1	6.6	6.3	6.6(LM+)	26.8	3.3	5.0	4.5(M+)	27.4

*The cotton grades are designated as follows:
1. Middling Fair (MF)
2. Strict Good Middling (SGM)
3. Good Middling (GM)
4. Strict Middling (SM)
5. Middling (M)
6. Strict Low Middling (SLM)
7. Low Middling (LM)
8. Strict Good Ordinary (SGO)
9. Good Ordinary (GO)

most waste, 10.5 percent, were classed 7.1(LM), a difference of nearly 1 grade. The machine-picked and hand-snapped cottons with little difference in waste, 0.8 percent, differed only 0.2 grade. The average percentages of waste correspond rather closely with the average composite grades of the uncleaned cottons.

Leaf grade is based on foreign matter, therefore, it would be expected that the average grades for leaf of the uncleaned cotton would correspond closely with the average percentage of waste. This was true. There was approximately 1 grade difference between the hand-picked with 5.9 percent waste and the machine-picked with 8.6 percent. There was a difference of only 0.1 grade for leaf between machine-picked and hand-snapped and approximately 1 percent difference in waste. There was also a difference of 0.1 grade and 1 percent waste between hand-snapped and machine-stripped.

For individual cottons, the wastes frequently do not correspond with the leaf grades. The waste of 1 cotton with a leaf grade of 4 exceeded in waste 6 of 18 cottons with a grade of 5, exceeded 4 of grade 6 and 1 of leaf grade 7. Cottons which contained 4.0 to 4.5 percent waste were found in leaf grades 5, 6 and 7. Wastes of 10 and 12 percent were found in each of leaf grades 6, 7 and 8. These discrepancies indicate that grade for leaf is frequently not a reliable indication of the amount of waste in a given cotton. The explanation in some cases may lie in the type of foreign matter. Cotton with fine, heavy, inconspicuous waste, such as sand, might be given a higher grade, but would have a higher percentage of waste by weight than a cotton with leaf trash which would occupy a larger area, but weigh less.

The averages of grades for color were, in general, lowered as the percentage of waste increased, although there were many exceptions for individual cottons.

The grades for leaf and color of the uncleaned cottons were identical for 82 of the 132 cottons. The waste for 1 cotton, which was given a grade of 4 for color, was greater than all but 3 of the 19 cottons graded 5, and greater than all but 12 of the 53 graded 6 for color. In many cases the percentage of waste shows no apparent reason for a sample being given a lower grade for leaf than for color. For example, 7 of the 9 samples with grades 5 for color were graded 6 for leaf, yet were among the cottons with the least waste.

Cleaned Cotton

It might be expected, since the cleaned samples were practically devoid of foreign matter, that the grade for leaf would be high and the grade for color more variable, depending on the presence of dullness, stains, tinges or other color defects.

The extent to which this assumption is true for averages for each method of harvesting is shown in Table 1.

The composite grades for the cleaned cottons differed a maximum of 0.8 grades between methods of harvesting, approximately the same difference as for the uncleaned samples. Hand-picked was graded 4.2(SM) and hand-snapped 4.5. Machine-picked was classed 4.6(M+) and machine-stripped 5.0 (M). There was a difference of 0.8 grade between the composite grades of the cottons with an average of 5.9 percent waste removed and those from which 10.5 percent waste had been removed.

The average grade for leaf for all cottons was 3.3, approximately SM+. The average grades for the 4 methods of harvesting were from 3.1 to 3.5, a difference of approximately 0.5 grade.

The grades for the color of all cottons were lower than those for leaf. The average color grade for the 132 cleaned cottons was 5.0. For the 4 methods of harvesting, the average grades of the cleaned cottons were 4.6 for hand-picked, 4.9 for snapped, 5.2 for machine-picked and 5.5 for stripped. These are in the same order as for the leaf grades.

Effect of Cleaning on Grade and Staple

The removal of waste from the 132 cottons raised the composite grade an average of 2.1 grades (Table 2). The cottons harvested by the 4 methods were improved approximately the same amount—2.0 grades for hand-picked, 2.1 grades for stripped, 2.3 grades for machine-picked and 2.2 for snapped. The hand-picked cottons with the least waste were improved approximately the same amount as the stripped with the most waste (Table 2).

The change in grade of individual cottons, however, often bears little relationship to the amount of waste removed. For example, the composite grades of 2 cottons with an average waste of 4.9 percent were lowered 0.5 grade by cleaning, but 1 cotton, with 5.6 percent waste, was improved 5 grades (Table

Table 2. The effect of cleaning on the grade, staple and price

Method of harvesting	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price difference
			Leaf	Color	Composite		
Hand-picked	59	5.9	2.9	1.4	2.0	+ .2	$+ 5.10
Machine-picked	9	8.6	3.6	1.6	2.3	0	+11.17
Hand-snapped	27	9.4	3.7	1.4	2.2	+ .4	+ 8.86
Machine-stripped	37	10.5	3.6	1.2	2.1	+1.7	+19.11
Average		8.1	3.3	1.3	2.1	+ .6	+10.21

3). Two samples with wastes of 7.9 percent were improved only 0.5 grade, but 61, with approximately the same average wastes, were improved 2 and 2.5 grades. The changes in composite grade for the 132 cottons ranged from a loss of 0.5 grade to an improvement of 5 grades.

Table 3. Average waste for leaf, color and composite grades for each change in grade

Changes in grade	Leaf grade		Color grade		Composite grade	
	No. of cottons	Waste, %	No. of cottons	Waste, %	No. of cottons	Waste, %
— .5					2	4.9
—1			3	6.4		
0			24	7.3	3	6.3
.5					2	7.9
1	3	5.2	52	8.4	18	7.7
1.5			1	11.0	12	8.9
2	22	5.9	29	8.2	46	7.9
2.5			2	5.7	15	7.8
3	51	7.7	16	8.5	20	8.4
3.5	1	5.1			6	8.3
4	42	9.1	5	8.7	7	11.0
4.5						
5	12	11.4			1	5.6
5.5						
6	1	5.6				

The leaf grades of the 132 cottons were improved by cleaning an average of 3.3 grades (Table 2). Hand-picked with the least waste, 5.9 percent, was improved the least—2.9 grades. Machine-picked with 8.6 percent waste was improved 3.6 grades, snapped with 9.4 percent waste 3.7 grades and stripped with 10.5 percent waste was improved 3.6 grades.

The leaf grade was improved by cleaning from 1 to 6 grades. All but 4 of the 132 samples were improved from 2 to 5 grades. Approximately equal wastes were contained in 5 cottons, 3 of which were improved by cleaning 1 grade in leaf, 1 by 3.5 grades and 1 cotton by 6 grades (Table 3).

Cleaning improved the color an average of 1.3 grades (Table 2). Machine-picked cottons were improved 1.6 grades. The cottons which were hand-picked and hand-snapped were each improved 1.4 grades. The stripped cottons were improved 1.2 grades in color. There was a maximum difference of slightly less than 0.5 grade in improvement in color grade between methods of harvesting.

The color grades of 3 cottons were lowered 1 grade after cleaning. The color grades of 24 cottons were not changed by cleaning. Improvements of 1 and 2 grades followed the cleaning of 82 cottons. The greatest improvement was 4 grades for 5 cottons, with an average waste approximately the same as for 52 which were improved 1 grade and as for 16 which were improved 3 grades. The amount of waste apparently had little

effect upon the direction or extent of the change in grade for color.

Cleaning did not affect the average length of the machine-picked cottons (Table 2). The average lengths of the hand-picked and snapped cottons were slightly increased. The greatest change was in the stripped with an average increase of between 1/32 and 2/32 inch.

For individual cottons, however, the staple was changed by removing the waste in all but 46 of the 132 cottons. Changes were 1/32 inch for 25 samples, 2/32 for 33, 3/32 for 4, 4/32 for 20 and 5/32 inch for 4 samples. The average change in length for the 132 cottons was an increase of approximately 1/64 inch. The amount of waste removed apparently did not affect the direction or extent of the change in staple of individual cottons.

Effect of Cleaning on Price

It should be kept in mind that for the cleaned as well as the uncleaned samples, the grades and prices used, the only ones available, are those designed for ordinary ginned cotton containing a normal amount of foreign matter.

No commercial equipment comparable with the laboratory device, the Shirley analyzer, is available, therefore, the cost of cleaning cannot be taken into account.

The removal of waste from lint cotton affects in 3 ways the price for which it qualifies. First, it reduces the number of pounds available for sale from each 500-pound bale of uncleaned cotton. Second, it changes the grade. Third, cleaning may either lengthen or shorten the staple.

The removal of waste for some of the 132 cottons would have resulted in a loss in price despite the higher grade, even when there was no loss in staple, since the weight of the cotton was reduced sufficiently to offset the gain won by the higher grade. This was true for 17 cottons which lost from $0.15 to $8.84 per bale, an average loss of $4.71. The loss in weight due to cleaning was from 20 to 44.5 pounds, an average of 31 pounds for those which lost in price.

Twenty-three of the 59 hand-picked cottons lost by cleaning from $0.15 to $20.98 per bale. Thirty-six cottons gained from $0.23 to $38.42 per bale. The range in change of price was $59.40. The average change was a gain of $5.10 per bale.

The average change in price due to the cleaning of the 9 machine-picked cottons was a gain of $11.17 per bale. Seven cottons gained from $3.88 to $24.13. Two cottons lost $0.53 and $1.36 per bale. No machine-picked cotton showed a loss in price due to cleaning where the staple was not changed in the process.

Twenty of the 27 snapped cottons gained from $3.74 to $27.86 per bale. Seven lost from $2.50 to $18.29. The average change due to cleaning was a gain of $8.86 per bale.

Thirty-three of the 37 stripped cottons gained from $0.02 to $48.63 per bale. Four cottons lost from $1.26 to $7.87. The average change was a gain of $19.11 per bale. The range was $56.50.

The price changes due to cleaning of the 132 cottons were from a loss of $20.98 to a gain of $48.63, a range of $69.61. There were 96 cottons which gained in value and 36 which lost by cleaning. The average change in price due to cleaning was a gain of $10.21 per bale.

Effect of Method of Harvesting and Location on Improvement by Cleaning

If such information is available, classers are prone to place much weight upon the region where the cotton was grown and the method of harvesting, basing their judgment upon past experience with such cotton rather than on the quality of the particular cotton being classed. They thus use their own standards instead of official government standards. This may result in the quality of a cotton being classed either too high or too low. For these reasons, the classers used in this experiment were not told the region where the cottons were grown nor the method of harvesting.

Four methods of harvesting were employed at College Station. Approximately the same number of samples were obtained in three of them. This made possible a comparison of improvements following cleaning for each of the methods of harvesting (Table 4).

Table 4. Effect of cleaning on cotton from the same location harvested by different methods

Location and method harvesting	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price per bale
			Leaf	Color	Composite		
College Station							
Hand-picked	23	5.2	2.7	2.0	2.4	+ .2	$ + 3.93
Machine-picked	3	7.7	3.7	1.3	2.0	—.3	+10.22
Hand-snapped	20	9.4	3.8	1.5	2.4	+ .2	+ 9.41
Machine-stripped	22	11.3	4.0	1.6	2.4	+1.2	+20.51
Chance Plantation							
Hand-picked	7	5.9	2.9	1.4	1.8	— .3	— 3.91
Machine-picked	6	9.0	3.5	1.7	2.4	+ .2	+11.64
Snook							
Hand-picked	11	4.8	2.4	1.1	1.8	—1.0	— 4.70
Hand-snapped	2	11.1	3.0	.5	.8	— .5	+ .75
Lubbock							
Hand-snapped	5	8.8	3.6	1.2	2.1	+1.2	+ 9.92
Machine-stripped	15	9.4	2.9	.8	1.7	+2.5	+17.05

The average waste ranged from 5.2 percent for hand-picked to 11.3 percent for machine-stripped cottons. The improvement in composite grade was identical for 3 of these methods, 2.4 grades, and for the fourth, machine-picked, 2.0 grades. In only one case, the machine-stripped, did the classer find a significant change in staple, a gain of 1/32 inch.

The average changes in price due to cleaning ranged from a gain of $3.93 for the hand-picked, with 5.2 percent waste removed, to a gain of $20.51 per bale for the machine-stripped with 11.3 percent waste removed.

Samples of Deltapine cotton from 13 bales were obtained from the Chance plantation near College Station. Seven were hand-picked and 6 machine-picked. The 2 methods of harvesting were carried on simultaneously. These samples offer the best comparison of these 2 methods of harvesting, as the variety, location and dates of harvesting were the same. The waste of these 13 samples and the changes in grade, staple and price due to cleaning are given in Table 4.

The 7 hand-picked samples contained an average of 5.9 percent waste, and the 6 machine-picked, 9.0 percent waste. The hand-picked uncleaned samples were given an average composite grade of 5.9 and the machine-picked a composite grade of 6.8, a difference of approximately 1 grade due to method of harvesting. Both the hand-picked and machine-picked samples were given an average staple of 29/32 inch. Cleaning had no significant effect on the staple.

The average composite grade for the 7 hand-picked cottons was 4.1 after cleaning, an improvement of 1.8 grades over the uncleaned samples. The leaf grade was improved by cleaning 2.9 grades and color 1.4 grades.

The 6 machine-picked cottons were given an average composite grade of 6.8 before cleaning and 4.4 after the removal of 9 percent waste, an improvement of 2.4 grades.

The average leaf grades of the 6 machine-picked samples were 7.0 before cleaning and 3.5 grades after cleaning, an improvement of 3.5 grades. The average color grades were 6.7 before cleaning, and 5.0 after cleaning, an improvement of 1.7 grades. The machine-picked with 3 percent more waste were improved approximately 0.5 grade more in leaf, color and composite grade than the hand-picked.

The 7 hand-picked samples lost an average of $3.91 per bale by the removal of 5.9 percent waste. The 6 machine-picked samples gained an average of $11.64 by the removal of 9 percent waste.

Although 2 samples are not enough for reliable conclusions, comparisons of the samples from Snook (Table 4) show that

the 2 snapped samples were improved 1 grade less than the 11 hand-picked samples. The hand-picked lost 1/32 inch by cleaning. The removal of 4.8 percent waste from the hand-picked decreased the price $4.70 per bale. Removing 11.1 percent waste from the snapped increased the price only $0.75 per bale.

The snapped and stripped samples from Lubbock contained approximately the same percentage of waste. Cleaning raised the composite grade of snapped 2.1 grades and increased the staple 1/32 inch. The increase in price per bale was $9.92. The stripped was improved 1.7 grades, gained more than 2/32 inch in staple and $17.05 per bale.

The effect of cleaning of cottons harvested by the same methods at different locations is shown in Table 5.

Table 5. Effect of cleaning on cotton harvested by the same methods at different locations

Method of harvesting and location	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price per bale
			Leaf	Color	Composite		
Hand-picked							
College Station	23	5.2	2.7	2.0	2.4	+ .2	$ + 3.93
Chance Plantation	7	5.9	2.9	1.4	1.7	— .3	— 3.91
Snook	11	4.8	2.4	1.1	1.8	—1.0	— 4.70
Main Station Farm	18	7.5	3.7	.9	1.9	+ .9	+16.08
Machine-picked							
College Station	3	7.7	3.7	1.3	2.0	— .3	+10.22
Chance Plantation	6	9.0	3.5	1.7	2.4	+ .2	+11.64
Hand-snapped							
College Station	20	9.4	3.8	1.5	2.4	+ .2	+ 9.41
Snook	2	11.1	3.0	.5	.8	— .5	+ 0.75
Lubbock	5	8.8	3.6	1.2	2.1	+1.2	+ 9.92
Machine-stripped							
College Station	22	11.3	3.9	1.6	2.4	+1.2	+20.51
Lubbock	15	9.4	2.9	.8	1.7	+2.5	+17.05

The 18 hand-picked samples from the Main Station Farm were of the same variety but represented different picking dates. An interval of 36 days elapsed between the first and last pickings. No sample was exposed to more weathering than another, as all cotton open on each picking date was picked. Differences in the amount of waste between picking dates were no greater than between samples harvested on the same date. There appeared to be no significant differences in grade and staple, either before or after cleaning, which could be attributed to the date of picking.

In general, the cottons with the most waste removed by cleaning were improved the most in leaf grade and in price per bale. This increase was, however, not always due to a greater improvement in grade over those with less waste but to an increase in staple after cleaning.

Three of the locations where 59 cottons were hand-picked represent single farms or plantations and are called in this study, College Station, Main Station Farm and the Chance plantation. The fourth location, Snook, includes 4 varieties of cotton from 10 farms.

There was only 0.1 grade difference between the improvement in the composite grade of the samples from Snook with the least waste, 4.8 percent, and those from the Main Station Farm with the most waste, 7.5 percent. The cottons from College Station contained 5.2 percent waste and were improved the most by cleaning.

There were no great differences in percentage of waste and in improvement in composite grade following cleaning between the 2 locations where cotton was machine-picked.

The cottons snapped at College Station and Lubbock contained approximately the same percentage of waste. They were improved by cleaning approximately the same amount both in grade and price. However, those at Lubbock were 1/32 inch longer after cleaning. The 2 samples from Snook contained more waste than those from College Station or Lubbock, and were improved by cleaning less in grade and by only $0.75 per bale.

The 22 machine-stripped cottons from College Station contained more waste and were improved more in grade by cleaning than the 15 stripped at Lubbock. The College Station samples were 1/32 inch longer and the Lubbock samples more than 2/32 inch longer after cleaning. The increases in price were $20.51 for the College Station stripped and $17.05 for the Lubbock stripped cottons.

Differences in the percentage of waste do not always explain the differences in grade, staple and price either before or after cleaning.

Report for Classer B

Uncleaned Cotton

Grouped by method of harvesting, the average wastes, and the average grades and staples assigned by classer B to the uncleaned and cleaned cottons, are given in Table 6.

The hand-picked with the least waste received the highest average grade for leaf, color and composite grade. There was little difference between the grades assigned the uncleaned samples harvested by the other 3 methods.

When the wastes are averaged for each leaf grade, it is found that, in general, the cottons with the lowest average leaf grade contained the most waste, however, there were many exceptions among individual samples. Seven of those cottons

which were given a leaf grade of 6 contained less waste than a number of those graded 4 for leaf. The one cotton which was given a grade of 3 for leaf contained more waste than any given a grade of 4, more than all but 3 of the 25 given a leaf grade of 5, and more than all but 12 of the 30 graded 6. One of the cottons with a leaf grade of 7 contained less waste than the 1 cotton graded 3.

The percentages of waste show no reason for some samples being given a lower grade for leaf than for color. For example, 3 of the 8 graded 6 for leaf and 5 for color had less waste than the 1 cotton given a grade of 3 for leaf and 4 for color. The wastes of 2 of 17 cottons given a color grade of 5.5 were greater than all but 3 of the 19 graded 6.5, and greater than all but 9 of the 46 graded 7 and 7.5.

The grades for color and leaf were identical for 77 of the 132 cottons.

The averages of grades for color were, in general, lowered as the percentage of the waste increased, although there were many exceptions for individual cottons.

Cleaned Cotton

The leaf grades for the hand-picked and machine-picked samples were the same after cleaning, 1.4 grades. The snapped and stripped cottons were given the same leaf grade, 1.7 (Table 6).

The machine-picked samples were given a slightly higher grade for color, 2.2, than the hand-picked, 2.5. Hand-snapped cottons were graded higher for color, 2.7, than machine-stripped, 3.2.

The average leaf grades were higher for each of the 4 methods of harvesting than the average color grades. The average leaf grade for the 132 cleaned cottons was 1.5 and the average color grade was 2.7, a difference of slightly over 1 grade.

Table 6. The average waste, grade and staple of uncleaned and cleaned cotton

Method of harvesting	No. of cottons	Uncleaned					Cleaned				
		Waste, %	Grade			Staple, 32nd inch	Grade			Staple, 32nd inch
			Leaf	Color	Composite		Leaf	Color	Composite	
Hand-picked	59	5.9	5.6	5.8	5.8(SLM)	30.1	1.4	2.5	2.1(SGM)	30.0
Machine-picked	9	8.6	6.8	6.6	6.7(LM+)	30.8	1.4	2.2	1.9(SGM)	30.8
Hand-snapped	27	9.4	6.8	6.4	6.6(LM+)	29.4	1.7	2.7	2.3(SGM)	29.3
Machine-stripped	37	10.5	6.9	6.6	6.8(LM)	28.8	1.7	3.2	2.8(GM)	29.0
Average		8.1	6.3	6.2	6.3(LM+)	29.6	1.5	2.7	2.3(GM+)	29.6

The machine-picked cottons were given the highest composite grade, 1.9, followed in order by hand-picked, 2.1; snapped, 2.3; and stripped cottons, 2.8 grades. There was nearly 1 grade difference between the machine-picked and machine-stripped cottons. The average composite grade for the 132 cleaned cottons was 2.3, approximately GM+.

Effect of Cleaning on Grade and Staple

The composite grades of the 132 cottons were raised by cleaning an average of 4.0 grades. The improvements following cleaning ranged from 3.7 grades for the hand-picked to 4.8 grades for the machine-picked (Table 7).

Table 7. The effect of cleaning on the grade, staple and price

Method of harvesting	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price difference
			Leaf	Color	Composite		
Hand-picked	59	5.9	4.2	3.3	3.7	—.1	$ +1.00
Machine-picked	9	8.6	5.4	4.4	4.8	0	+11.41
Hand-snapped	27	9.4	5.1	3.7	4.3	—.1	+9.08
Machine-stripped	37	10.5	5.2	3.4	4.0	+.2	+10.74
Average	.....	8.1	4.8	3.5	4.0	0	+6.09

In leaf grade, the hand-picked cottons with the least waste removed were improved the least of the 4 methods of harvesting, 4.2 grades. Machine-picked samples contained slightly less waste than snapped or stripped samples, but were improved more in leaf grade, 5.4 grades. The leaf grades of snapped and stripped cottons were improved by cleaning approximately the same amount, 5.1 and 5.2 grades, respectively.

The color grades of the cottons were improved less by the removal of waste, 3.5, than were the leaf grades, 4.8.

The color grade of hand-picked cottons with the least waste was improved approximately the same amount as the machine-stripped with the most waste. Although machine-picked cottons contained less waste, the color grade was improved more by cleaning than was the color grade of the snapped or the stripped cottons.

The average wastes for leaf, color and composite grades for each change in grade are given in Table 8.

The leaf grade was improved by cleaning from 2 to 6 grades. The 2 samples which were improved 2 grades contained more waste, 5.9 percent, than the 10 which were improved 3 grades, 4.4 percent.

The improvement in leaf grade due to cleaning was 4 grades for 35 samples, 5 grades for 56 and 6 grades for 29 samples.

Table 8. Average waste for leaf, color and composite grades for each change in grade

Changes in grade	Leaf grade		Color grade		Composite grade	
	No. of cottons	Waste, %	No. of cottons	Waste, %	No. of cottons	Waste, %
0						
.5						
1			1	7.2		
1.5						
2	2	5.9	16	7.4	3	5.1
2.5					9	7.1
3	10	4.4	49	8.0	16	6.4
3.5					28	7.8
4	35	6.3	47	8.2	20	8.0
4.5					30	8.4
5	56	9.2	19	8.8	19	10.0
5.5					6	9.1
6	29	9.5			1	10.4

The color grade of 1 cotton was improved by cleaning only 1 grade. Ninety-six cottons were improved 3 and 4 grades. There was a difference of only 1.6 percent waste between the cotton improved 1 grade for color and the 19 which were improved 5 grades.

Improvements in composite grade after cleaning were from 2 grades for 3 cottons with 5.1 percent waste, to 6 grades for 1 cotton with 10.4 percent waste. In general, the improvement in grade increased as the percentage of waste removed increased.

The average improvement in grade due to cleaning of the 132 cottons was 4.8 grades for leaf, 3.5 for color and 4.0 for composite grade.

There was no significant change in staple due to cleaning for cottons harvested by any of the 4 methods.

Effect of Cleaning on Price

The removal of waste from the 132 cottons resulted in an average increase in price of $6.09 per bale (Table 7). Eighty-two cottons gained and 50 lost in price per bale.

The 59 hand-picked samples, which had the least waste, gained the least, an average of $1.00 per bale. The change in price was from a loss of $15.64 to a gain of $32, a range of $47.64. Twenty-four samples gained from $0.01 to $32 and 35 samples lost from $0.08 to $15.64 per bale.

The 9 machine-picked cottons gained an average of $11.41 per bale. Eight gained from $8.33 to $23.67, and 1 lost $8.36 per bale, a range of $32.03.

The average gain for the 27 snapped cottons was $9.08 per bale. Six samples lost from $2.82 to $11.35 and 21 gained from $2.49 to $33.78 per bale. There was a range in change of price per bale of $45.13 for the snapped cottons.

The average change in price due to cleaning of the 37 stripped cottons was a gain of $10.74 per bale. Gains ranged from $0.60 to $34.83 per bale for 29 samples. Losses ranged from $0.23 to $13.15 for 8 cottons. There was a range in the change in price per bale of $47.98.

There were 15 samples of 1 variety from the same plantation, 7 of which were hand-picked and 6 machine-picked. Each of the 7 hand-picked samples lost in price by the removal of waste. The average loss was $2.48 per bale. Each of the 6 machine-picked samples gained in price. The gains were from $8.33 to $15.96, an average gain of $12.63 per bale.

For these cottons the removal of 5.8 percent waste from the hand-picked samples did not raise the grade and staple sufficiently to compensate for the loss in weight. The removal of 9.0 percent waste from the machine-picked samples improved the grade to a degree which more than compensated for the loss in weight.

For this one variety and location, the removal of waste from the hand-picked samples would have resulted in an average loss of $2.48 per bale. In contrast, the removal of waste from the machine-picked samples would have resulted in a gain of $12.63 per bale.

Effect of Method of Harvesting and Location on Improvement by Cleaning

The improvement following cleaning was the same, 3.8 grades, for the composite grade for 3 methods of harvesting at College Station, but 0.6 grade more, 4.4 grades, for the snapped samples (Table 9). The hand-picked and machine-picked samples were improved the same in color. The stripped were improved less and the snapped slightly more in color grade than were

Table 9. Effect of cleaning on cotton from the same location harvested by different methods

Location and method of harvesting	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price per bale
			Leaf	Color	Composite		
College Station							
Hand-picked	23	5.2	4.0	3.7	3.8	+ .3	$ — 0.15
Machine-picked	3	7.7	4.7	3.7	3.8	+ .3	+ 8.97
Hand-snapped	20	9.4	5.2	3.9	4.4	+ .1	+11.37
Machine-stripped	22	11.3	5.3	3.2	3.8	+ .3	+15.01
Chance Platation							
Hand-picked	7	5.9	4.4	3.4	3.9	0	— 2.48
Machine-picked	6	9.0	5.7	4.7	5.2	— .2	+12.63
Snook							
Hand-picked	11	4.8	3.5	3.0	3.1	—1.2	— 7.60
Hand-snapped	2	11.1	5.5	2.5	3.2	— .5	+21.72
Lubbock							
Hand-snapped	5	8.8	5.0	3.6	4.4	— .4	— 5.12
Machine-stripped	15	9.4	4.9	3.5	4.3	+ .1	+ 4.47

the hand-picked and machine-picked samples. The hand-picked samples were improved the least in leaf, 4.0 grades, and the stripped the most, 5.3 grades. Snapped samples were improved approximately the same in leaf grade as were stripped samples. Machine-picked samples were improved more in leaf than hand-picked but less than snapped or stripped.

The maximum difference in change in price per bale due to method of harvesting at College Station was $15.16. Cottons which were hand-picked lost $0.15 per bale and those harvested by the other 3 methods gained $8.97, $11.37 and $15.01, respectively.

There was no significant difference in the change in staple following cleaning which was due to the method of harvesting at College Station.

The machine-picked samples from the Chance plantation were improved 1.3 grades more for leaf, color and composite grade than were the hand-picked samples. There was no significant difference in the staples. The hand-picked samples lost $2.48 per bale following cleaning and the machine-picked gained $12.63, a difference of $15.11 due to method of harvesting (Table 9).

The 2 hand-snapped cottons from Snook were improved 2 grades more in leaf than were the 11 hand-picked cottons. Hand-picked samples were improved 0.5 grade more in color than snapped samples. There was no significant difference in composite grades between the 2 methods of harvesting. The picked samples lost slightly more in length of fiber than did the snapped samples. The hand-picked samples lost $7.60 per bale by cleaning and the snapped gained $21.72, a difference of $29.32 between the 2 methods of harvesting at Snook.

There was a difference of only 0.1 grade in leaf, color and composite grades between the cottons which were snapped and those which were stripped at Lubbock. There was a difference of $9.59 in change in price following cleaning, as those which were snapped lost $5.12 and those stripped gained $4.47 per bale (Table 9).

Cottons harvested by the same method but at different locations differed from less than 0.5 to 1.5 composite grades in their improvement following cleaning (Table 10).

The smallest differences between locations in improvement in grade were for the stripped cottons from College Station and Lubbock. These differed 0.5 grade or less for leaf, color and composite grade. There was a difference between the 2 locations of $10.54 per bale in the change in price.

The maximum differences between any 2 of the 4 locations where hand-picking was used were 1.5 grades for leaf, 0.7

grade for color and 0.8 grade for the composite grade. At 3 locations, the hand-picked cottons lost from $0.15 to $7.60 per bale following cleaning. At the fourth location, the Main Station Farm, greater waste was removed than at the other 3 locations and there was a greater improvement in price due to cleaning.

Cotton was machine-picked at 2 locations. There was a difference between the 2 locations of slightly over 1 grade and of $3.66 per bale in the improvement following cleaning.

Among the 3 locations where cotton was snapped, there was a maximum difference in improvement following cleaning of 1.4 grade for color, 0.5 grades for leaf, 1.2 grades for composite grade and $26.84 per bale (Table 10).

Table 10. Effect of cleaning on cotton harvested by the same methods at different locations

Method of harvesting and location	No. of cottons	Waste, %	Changes due to cleaning				
			Grade			Staple, 32nd inch	Price per bale
			Leaf	Color	Composite		
Hand-picked							
College Station	23	5.2	4.0	3.7	3.8	+ .3	$— 0.15
Chance Plantation	7	5.9	4.4	3.4	3.9	0	— 2.48
Snook	11	4.8	3.5	3.0	3.1	—1.2	— 7.60
Main Station Farm	18	7.5	5.0	3.1	3.6	+ .1	+ 9.08
Machine-picked							
College Station	3	7.7	4.7	3.7	3.8	+ .3	+ 8.97
Chance Plantation	6	9.0	5.7	4.7	5.2	— .2	+12.63
Hand-snapped							
College Station	20	9.4	5.2	3.9	4.4	+ .1	+11.37
Snook	2	11.1	5.5	2.5	3.2	— .5	+21.72
Lubbock	5	8.8	5.0	3.6	4.4	— .4	— 5.12
Machine-stripped							
College Station	22	11.3	5.3	3.2	3.8	+ .3	+15.01
Lubbock	15	9.4	4.9	3.5	4.3	+ .1	+ 4.47

Cotton was snapped at 3 locations. The leaf was improved the most at Snook, 5.5 grades, and the least at Lubbock, 5.0 grades. The College Station cottons were improved most in color and the Snook the least, a difference of 1.4 grades. The composite grades of the Lubbock and College Station samples were raised by the same amount, 4.4 grades, and Snook by 3.2 grades. The maximum difference in change in price per bale was $26.84, between Lubbock which lost $5.12 and Snook which gained $21.72.

Fibrograph Measurements of Length

As there were wide differences between the classers, the lengths of the 132 samples both before and after cleaning were determined with the Fibrograph to see if this method would reveal any appreciable change in length due to cleaning. It was found that the average change was not statistically sig-

Table 11. Classers' staple and Fibrograph upper half mean before and after cleaning

Classers' mean length and upper half mean, inches	Uncleaned	Cleaned
Classer A	.84 ± .006	.86 ± .004
Classer B	.93 ± .005	.93 ± .004
Fibrograph upper half mean	.91 ± .007	.91 ± .007

nificant, but that there appeared to be a slight tendency for long-fibered cotton to be slightly shorter and short-fibered cotton to be slightly longer after cleaning (Table 11 and Figure 1). Presumably, some of the longest fibers might have been broken and some of the shortest fibers removed during the cleaning process.

It was found that the average upper half mean for the uncleaned samples was .91 inch. Conversion of staples for classers A and B to decimals gives .84 inch for A and .93 for B. For the cleaned samples, the upper half mean is also .91 inch, the staple for A is .86 and for B .93 inch. The measurements made with the Fibrograph gave a slightly higher correlation with the staples assigned by classer B, .72 for uncleaned and .69 for cleaned, than for those with classer A, .56 for the uncleaned and .58 for the cleaned samples.

The staple as given for classer B for both the uncleaned and cleaned samples agreed closely with the measurements given by the Fibrograph. It appears that classer A routinely called the staple short, but his results for the uncleaned and cleaned samples are consistent. It appears both by the Fibrograph and the 2 classers that the cleaning had no effect on the average length of the fiber.

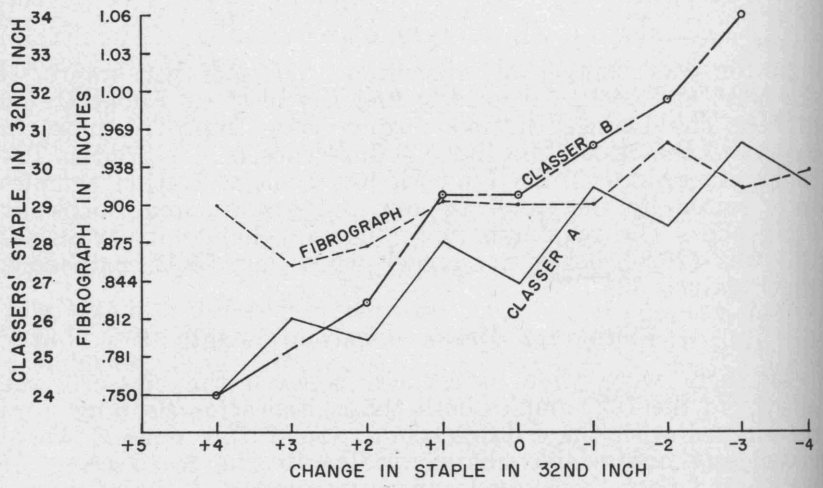

Figure 1. Relation between length and change in staple when cleaned.

Comparison of Classifications

Grade and Staple of Uncleaned Cotton

Of the 5 cottons sent in duplicate (10 samples) to one classer, the same grade was assigned for 3 cottons, 1 of which also was given the same staple. Duplicate samples differed 0.5 grade for 1 cotton and 2 grades for the fifth cotton. In staple, the duplicate samples differed 1/32 inch for 1 cotton, 1/16 inch for 2, and 1/8 inch for 1 cotton. The last named cotton was said to be slightly irregular, which may account for such a wide difference.

Of the 10 cottons sent in duplicate (20 samples) to the other classer, the same grade was assigned to duplicates of 3 cottons, 2 of which were given the same staple. For the remaining 7 cottons, duplicate samples differed 0.5 grade for 2, 1 grade for 3 and 1.5 grades for 2 cottons. Of the 10 cottons, duplicate samples of 5 were given the same staple, duplicates of 1 cotton differed 1/32 inch, 2 differed 1/16 inch and 2 differed 1/8 inch. Five of these 10 cottons were said to be slightly irregular, but they included 3 of the 5 for which duplicate samples were given the same staple and included only 1 of those for which duplicate samples differed 1/8 inch.

Differences between the grades and staples of duplicate samples resulted in differences in price per bale ranging from $2.30 to $39.25 for one classer and from $5.30 to $31.50 for the other classer.

It is believed that it would be difficult to find classers superior in judgment and experience to those who classed the cottons used in this study, but it is seen that they were frequently unable to check with themselves. It cannot be said that these Texas classers were asked to class duplicates of unfamiliar cotton, since they were normal, ginned Texas cottons not yet cleaned by the Shirley analyzer.

Table 12. Differences between classers by grade giving number of cottons for each grade difference

Grade difference	Number of cottons					
	Uncleaned			Cleaned		
	Leaf grade	Color grade	Composite grade	Leaf grade	Color grade	Composite grade
0	68	74	55	5	4	3
.5	1	1	43	.....	.....	6
1	60	52	28	45	26	11
1.5	.....	.....	4	.....	2	30
2	2	5	1	65	51	21
2.5	.....	.....	1	.....	.....	27
3	1	.....	.....	15	30	12
3.5	.....	.....	.....	.....	.....	21
4	.....	.....	.....	2	19	.....
4.5	.....	.....	.....	.....	.....	1
Number differing by 2 or more grades	3	5	2	82	100	82

The magnitude of the differences in grades assigned by the 2 classers are shown in Table 12. The 2 classers agreed closely on the average grades of the 132 uncleaned cottons but frequently differed widely for individual cottons. There was a range in grade from 5 to 8 grades for classer A and from 4 to 8.5 grades for classer B. The classers differed only 0.3 grade for the average composite grade of the 132 uncleaned samples but agreed on the composite grade of only 55. They differed from 1 to 2.5 grades for the composite grades of 34 cottons.

The classers differed 0.3 grade for the average leaf grade. They gave the same leaf grades to 68 uncleaned samples. They differed 1 grade for 60, 2 grades for 2 and 3 grades for 1 sample.

The difference between classers for the average color grade was only 0.1 grade, but 57 samples differed 1 and 2 grades. The color grades for 74 samples were identical.

Classer A gave a difference of 0.9 between the composite grades of the cottons with an average of 5.9 percent waste and those with 10.5 percent waste. For the same cottons, classer B gave a difference of 1 grade. In general, the highest average grades were assigned to samples which contained the least waste. For both classers, the cottons with intermediate wastes, 8.6 and 9.4 percent, the grades were also intermediate, but not in the same order. Classer A found the cottons with 9.4 percent waste had a slightly higher, but B a slightly lower grade than those with 8.6 percent waste removed. However, differences of 1 percent in waste are probably not significant.

The percentages of waste found in the cottons within each composite grade are given for each classer in Table 13. Although there sometimes were wide differences in the ranges of waste, the averages for the 2 classers within each grade did not differ greatly.

The classers differed more in staple of the uncleaned samples than in grade. Classer A gave a shorter average staple for each method of harvesting than classer B. Classer A found the average length of the 132 uncleaned cottons was 26.8 in thirty-

Table 13. Waste falling within each grade for uncleaned cottons

	Composite grades for uncleaned samples									
	Grade 4 and 4½		Grade 5 and 5½		Grade 6 and 6½		Grade 7 and 7½		Grade 8 and 8½	
	Waste		Waste		Waste		Waste		Waste	
Classer	Range	Av.	Range	Av.	Range	Av.	Range	Av.	Range	Av.
A			4.0— 6.6	4.8	3.8—13.7	7.0	5.7—17.6	9.2	5.6—23.2	11.6
B	3.8— 6.6	4.7	4.1—12.3	5.9	3.8—16.0	7.3	5.7—17.6	9.8	10.3—23.2	14.3

seconds of an inch, but classer B found the average length was 29.6, a difference of nearly 3/32 inch.

They differed more than 2/32 inch for the uncleaned hand-picked and snapped cottons and nearly 3/32 inch for the machine-picked cottons. The greatest difference between classers was for the stripped cottons, nearly 4/32 inch.

Classer A gave shorter staples than B for 118 samples, the same for 12 and longer for 2 of the 132 uncleaned cottons. Classer A found that 39 cottons were 3/4 inch, but B only 3 (Table 14). Classer A thought only 2 cottons were as long as 1 inch, but classer B thought 12 were 1 inch and that 6 were longer. Classer A found that 10 cottons were from 15/16 to 1 inch, but B found 73 were within this range.

Table 14. **Frequency distribution of staple for uncleaned and cleaned cotton as estimated by 2 classers**

Staple, 32nd inch	Uncleaned		Cleaned	
	Classer			
	A	B	A	B
24	39	3	14	.....
25	.....	.....	.....	.....
26	19	10	21	8
27	.....	.....	.....	.....
28	49	17	73	18
29	15	23	22	21
30	6	42	2	56
31	2	19	.....	19
32	2	12	.....	9
33	.....	3	.....	1
34	.....	3	.....	.....

The classers agreed on the staple of only 12 cottons (Table 15). They differed 2/32 inch for 35 cottons, 4/32 for 15 and 6/32 for 16 cottons. They differed from 2/32 to 6/32 inch inclusive for 103 of the uncleaned samples.

Grade and Staple of Cleaned Cotton

The 2 classers differed widely in grades for the cleaned samples. There was a difference of 2.2 grades between the average of the composite grades given by the 2 classers for the 132 cleaned samples (Tables 1 and 6). Classer A gave an average of 4.5, or M+, and classer B an average grade of 2.3, or approximately GM+. The least difference between the classers for the different methods of harvesting was 2.1 grades for the 59 hand-picked cottons and the greatest was 2.7 grades for the 9 machine-picked samples.

For only 3 samples were the composite grades identical, in contrast with 55 for the uncleaned samples (Table 12). The classers differed by 1.5 grades for 30 samples, by 2.5 grades for 27, by 3.5 for 21 and by 4.5 grades for 1 sample. There was a difference of 2 or more grades between classers for 82 of

the 132 cottons in contrast with only 2 samples of the uncleaned cotton.

With practically all the foreign matter removed, it seems that grade for leaf should be very high, perhaps grade number 2(SGM), if not grade number 1(MF). Classer B found the average grade for leaf to be 1.5(SGM+), but classer A only 3.3, approximately SM+, a difference of nearly 2 grades (Tables 1 and 6). The question arises as to whether classer A gave the cleaned samples too low a grade for leaf. Perhaps he was influenced by the recollection that none of these samples in the uncleaned state was above Middling, grade 5.

The averages for the cleaned samples representing the 4 methods of harvesting, with wastes removed ranging from 5.9 to 10.5 percent, differed a maximum of 0.4 grade for leaf for classer A and 0.3 grade for B (Tables 1 and 6). Therefore, each classer found little difference in the average leaf grades of the cleaned samples regardless of previous waste content.

The differences between classers for the average grades for leaf range from 1.6 for snapped to 1.9 grades for machine-picked. Individual leaf grades of 2, 3, 4 and 5 were included for classer A, and grades 1, 2 and 3 for classer B.

In grades for leaf, the classers agreed for only 5 cleaned samples (Table 12). They differed by 1 grade for 45, by 2 grades for 65, by 3 grades for 15 and by 4 grades for 2 samples. Of the 132 cottons, the classers differed by 2 or more leaf grades for 82 cleaned samples, but for only 3 of the uncleaned samples.

For classer A, the average grades for color ranged from 4.6 for the 59 hand-picked cottons, from which 5.9 percent waste had been removed, to 5.5 for the 37 stripped samples from which 10.5 percent waste had been removed (Table 1). The average grades for color of the cleaned cottons were in the same relative position with respect to former waste content, as were the composite and leaf grades for classer A. Classer B found, however, that the samples which had an average waste of 8.6 percent removed were slightly higher in grade than those with only 5.9 percent removed. There was 0.5 grade difference between the cottons which had 9.4 and those with 10.5 percent waste removed.

There were greater differences between the classers for color grades than for leaf grades. Classer A assigned an average color grade of 5.0(M), in contrast with 2.7(GM+) assigned by classer B to the 132 cleaned samples. The classers differed 3 grades for the machine-picked cottons.

The classers assigned identical color grades to only 4 samples (Table 12). They differed by 1 grade for 26 samples, by

2 grades for 51, by 3 grades for 30 and by 4 grades for 19 samples.

If in determining the grade for color, the classer judged the combined effect of leaf and cotton in the uncleaned cotton, but, of necessity, only the cotton fiber in the cleaned state, then the color of the fiber in the uncleaned state is not known. If only the color of the fiber had been considered in both the uncleaned and cleaned states, it seems unlikely that the removal of foreign matter would have changed the color of the fibers themselves as much as the classers found, from grade 6.5 to grade 5 for classer A and from grade 6 to grade 2.5 for classer B. It is possible that classer B gave slight attention to the color of the cleaned fiber and assumed that since the leaf grade was high, the grade for color was also high. This possibility is in agreement with the frequent observation that classers tend to ignore color unless a cotton is obviously stained or discolored, yet color is one of the 3 factors included in grade. It, presumably, should receive as much attention as leaf and preparation.

The classers differed by 2 or more grades for the composite grade of 82 cleaned cottons, for leaf grade of 82 and for color grade of 100 cottons (Table 12). This is in contrast with 2 cottons for composite grade, 3 for leaf and 5 for color for which the classers disagreed by 2 or more grades for uncleaned cottons.

The classers differed slightly more than 2/32 inch in the average staple of the cleaned samples. The least difference between classers was for the snapped cottons, slightly less than 2/32 inch, and the most was for the machine-picked, nearly 3/32 inch.

Classer A judged 14 cottons to be 24/32 inch and 21 to be 26/32 (Table 14). Classer B found none as short as 24/32 and only 8 to be 26/32 inch. Only 2 cottons were assigned staples of 30/32 by A, but 56 were given this length by B. Classer B found 29 to be from 31/32 to 33/32, but A found none longer than 30/32 inch.

The classers agreed on the staple of 14 cleaned cottons (Table 15). They differed 1/32 inch for 18, 2/32 for 57, 3/32 for 27, 4/32 for 11, 5/32 for 3 and 6/32 for 2 cottons.

Table 15. Frequency distribution of differences between classers in staple

Difference, 32nd inch	Uncleaned cottons	Cleaned cottons
0	12	14
1	17	18
2	35	57
3	25	27
4	15	11
5	12	3
6	16	2

Classer A gave shorter staples than B for 236 of the 264 uncleaned and cleaned samples. They agreed on the staple of 26 of the 264 samples.

Changes in Grade and Staple Due to Cleaning

The differences between classers in their estimate of the grades and staples of the cottons are reflected in the changes in grade and staple due to cleaning.

The changes in composite grade due to cleaning for individual cottons range from 0 to 5 grades for classer A and from 2 to 6 for classer B (Table 16). The average change in grade for the 132 cottons was 2.1 for classer A and 4.0 for B, a difference of approximately 2 grades between classers (Table 17).

Table 16. Changes in grade due to cleaning as judged by 2 classers

Change in grade	Number of cottons					
	Leaf grade		Color grade		Composite grade	
	Classer					
	A	B	A	B	A	B
0			24		3	
.5					4	
1	3		55	1	18	
1.5			1		12	
2	22	2	29	15	45	3
2.5			2		16	9
3	51	10	16	51	20	16
3.5	1				6	29
4	42	35	5	46	7	19
4.5						30
5	12	56		19	1	19
5.5						6
6	1	29				1

Table 17. Frequency distribution of changes in staple due to cleaning and differences between classers

Change, 32nd inch	Number of cottons		
	Classer		Difference between classers
	A	B	
0	46	47	31
1	25	61	45
2	33	22	22
3	4	1	14
4	20	1	13
5	4		6
6			1

Classer A found that the composite grades for 37 samples were improved by cleaning from 0 to 1.5 grades, but classer B found that no cotton was improved so little, but that all samples were improved by 2 or more grades (Table 16). For classer A, 111 cottons were improved by cleaning from 1 to 3 grades, while for classer B, 113 samples were improved 3 to 5 grades. Classer A found that 3 samples were not im-

proved by cleaning and 4 samples by only 0.5 grade. Classer A found 45 samples to have been improved 2 grades, in contrast with only 3 samples according to classer B, the minimum improvement reported by B. The maximum improvement found by classer A was 5 grades, but for only 1 sample. Classer B found 26 samples to be improved 5 and 6 grades.

Since the composite grade in this study is composed of the combined effect of leaf and color, the separate grades for leaf and for color should show wherein the classers found their greatest disagreement.

Since all of the cleaned samples were almost completely devoid of foreign matter, it seems that each cotton would have received a high grade for leaf and that each would have had a much higher grade than when uncleaned. Also, since the classers differed little for the average leaf grades of uncleaned cottons (0.3 grade), it might be expected that the classers would have agreed rather closely for leaf grade of the cleaned samples and thus would have found approximately the same improvement in grade due to the removal of foreign matter. The classers did not agree closely, however, upon the leaf grades of the cleaned samples, therefore, did not agree on the extent of improvement due to the removal of foreign matter.

The leaf grades given to the individual cleaned samples ranged from grade 2(SGM) to grade 6(SLM) for classer A and from grade 1(MF) to 3(GM) for classer B. The improvement in leaf grade due to cleaning ranged from 1 to 6 grades for classer A and from 2 to 6 grades for classer B (Table 16), with averages of 3.3 and 4.8 grades, respectively (Tables 2 and 7).

The greatest improvement in leaf, according to classer A, was in snapped cotton, which was improved 3.7 grades. Classer B found the greatest improvement in machine-picked samples, which were improved an average of 5.4 grades (Tables 2 and 7).

The classers disagreed by 1.5 grades for the average change in leaf grade of the 132 cottons. They disagreed 1.3 grades for hand-picked, 1.7 for machine-picked, 1.3 for snapped and 1.6 for machine-stripped.

For 18 samples, the 2 classers agreed on the extent of the improvement in leaf grade following cleaning. For 94 samples they differed by 1 and 2 grades, and for 19 by 3 and 4 grades.

It appears that the classers must have considered some factors other than foreign matter in assigning leaf grades to the cleaned samples, or all cottons would have been more nearly the same grade, since they were almost completely devoid of foreign matter. If grade for leaf is based only upon foreign matter content, and the samples were all free of foreign mat-

ter, then they might be expected to be classed as MF, grade 1, or SGM, grade 2, for leaf. It seems possible that classer A may have been influenced by the color of the cotton and gave the samples a low grade for leaf as well as for color. It seems possible that classer B, upon finding the samples free of foreign matter, gave them a high leaf grade and assumed that the color was also good and, therefore, gave a high grade for color.

The 2 classers disagreed more widely on the change in grade of color produced by the removal of foreign matter than they did on leaf grade.

For the 132 cottons, classer A found the grade for color to have been improved an average of 1.3 grades while classer B found the change to be 3.5 grades, a difference between classers of 2 grades. Classer A found that the cottons for 2 of the 4 methods of harvesting were improved 1.4 grades, 1 by 1.2 grades, and the fourth method, machine-picked, by 1.6 grades. Classer B found the improvement to range from 3.3 for hand-picked to 4.4 grades for machine-picked cottons.

Classer A found that there was no change in the color of 24 samples, but an improvement of 1 grade for 55, 2 grades for 29, 3 grades for 16 and 4 grades for 5 samples (Table 16). Classer B found that only 1 sample was improved so little as 1 grade. Other changes for B were improvements of 2 grades for 15, 3 for 51, 4 for 46 and 5 grades for 19 samples.

From these differences between classers, it appears that the same factors were not considered in assigning grades for color. The question comes to mind as to how much attention each classer gave to the area and color of the foreign matter, how much to the color of the fiber, and how much to the combined effect of the color of foreign matter and fiber.

Nickerson[3] found by measuring the color of uncleaned cotton (both fiber and foreign matter) and the color of the cleaned cotton, that the grade was raised by 1 to 2.5 grades. The differences found by classer A, an average for the 132 cottons of 1.4 grades, fall within this range.

It seems possible that classer B, associating clean cotton with a good grade for color, gave too high a grade for the color of the cleaned cottons, which resulted in an apparent improvement of 3.5 grades.

In only 1 of the 4 lots of cotton, machine-stripped, did classer A find an average difference in staple, due to cleaning, of more than 1/32 inch. Average differences for all 4 methods of harvesting were insignificant for classer B and for 3 methods for classer A.

[3]Effect of Cleaning on Grade and Color of Cotton, by Dorothy Nickerson. USDA, PMA, Cotton Branch, April 1947.

For individual cottons, however, the classers frequently found considerable difference between the staple of the uncleaned and the cleaned samples. For example, classer A found that 28 samples changed from 3/32 to 5/32 inch, inclusive (Table 17). Classer B found that 24 samples changed from 2/32 to 4/32 inch, inclusive.

The removal of waste had no effect upon the length of 46 samples for classer A and none on 47 for classer B, but only 18 of these were the same samples. Classer A found that 54 samples gained in length and classer B found that 41 gained, 20 of which were included by both classers. Losses were reported for 32 samples by A and for 44 by classer B, 16 of which were the same cottons. For only 31 of the 132 cottons did the classers agree as to the degree of change in length due to the removal of waste. The classers differed in their estimation of change in length by 1/32 inch for 45 cottons, by 2/32 for 22, by 3/32 for 14, by 4/32 for 13, by 5/32 for 6 and by 6/32 inch for 1 cotton (Table 17).

Price

The differences between classers for the changes in grade and staple due to cleaning are reflected in the prices per bale which would have been received using each classification. It should be kept in mind that the grades and prices used, the only ones available, are those designed for ordinary ginned cotton with normal foreign matter.

The average price per bale of the 132 uncleaned cottons on the basis of the classing of A was $128.90. The average price per bale was $144.48, using the classifications of classer B. There was a difference of $15.58 per bale due to the differences between the classers' estimates of the grades and staples of the uncleaned samples. This difference was due chiefly to the difference in their estimates of staple.

Classer B found that the cottons harvested by each method were worth more per bale, both uncleaned and cleaned, than did classer A. The average differences between the classers for the 132 uncleaned cottons, cottons with which both classers were familiar, were $15.28 per bale. The differences between classers were $15.03 per bale for the hand-picked, $12.45 for the machine-picked, $11.05 for the snapped and $20.53 per bale for the stripped.

The differences between the 2 classers in their classifications of the 132 cleaned cottons, with which they were not familiar, resulted in a difference in the average price of $11.47 per bale, which is less than for the uncleaned samples. The differences between classers in prices of cleaned cottons were $10.93 per bale for hand-picked, $12.69 for machine-picked, $11.27 for snapped and $12.16 per bale for stripped cottons. The classers

differed more in the average price per bale for the uncleaned samples, with which they were familiar, than for the cleaned samples, with which they were not familiar.

Classer A found that 17 and classer B that 20 cottons were sufficiently reduced in weight by cleaning to more than offset the gain in price due to the higher grade. Only 4 of the cottons which thus lost were included by both classers.

The price changes per bale were from a loss of $20.98 to a gain of $48.63, a range of $69.61 for classer A, and from a loss of $15.64 to a gain of $34.83, a range of $50.47 for classer B. Classer A found that 96 cottons gained and 36 lost in price, and B found that 82 gained and 50 lost by cleaning.

The average increase in price of the 132 cottons due to cleaning was $10.21 per bale, according to classer A, and $6.09, according to classer B (Tables 2 and 7). That the average changes in price are so nearly the same for the 2 classers, despite the relatively wide differences in grades, is due in part to the fact that there were no premiums given for grades above GM, grade 3, on the date of the prices used in the calculations. For these reasons those 96 cleaned cottons to which classer B assigned grades SGM, grade 2, and MF, grade 1, received no higher price than those which were classed as GM, grade 3. With our present system of grading and at these prices, there was no advantage to the grower in attempting to produce cotton which graded above GM, grade 3.

Despite the small difference between averages for the 2 classers there are wide differences between classers for individual

Table 18. The gain or loss in price per bale with the weight of waste removed by cleaning

Change in price per bale	No. of cottons and av. waste in lbs. if price was a loss				No. of cottons and av. waste in lbs. if price was a gain			
	Classer				Classer			
	A		B		A		B	
	No.	Lbs.	No.	Lbs.	No.	Lbs.	No.	Lbs.
$ $								
0.00– 2.99	9	38.8	12	36.6	11	32.7	9	39.3
3.00– 5.99	11	34.6	13	27.0	14	42.3	8	52.5
6.00– 8.99	8	30.0	15	31.4	8	50.4	7	47.6
9.00– 11.99	1	26.0	5	25.8	6	45.4	10	45.8
12.00– 14.99	3	27.8	3	38.5	7	45.4	17	45.8
15.00– 17.99	.....	.....	2	27.5	8	50.7	13	45.2
18.00– 20.99	4	27.1	.....	.....	7	40.4	5	45.4
21.00– 23.99	.....	.....	.....	.....	11	42.3	5	50.8
24.00– 26.99	.....	.....	.....	.....	4	42.1	1	59.0
27.00– 29.99	.....	.....	.....	.....	8	48.6	1	45.0
30.00– 32.99	.....	.....	.....	.....	.....	.....	3	44.3
33.00– 35.99	.....	.....	.....	.....	1	52.0	3	46.2
36.00– 38.99	.....	.....	.....	.....	7	36.1	.....	.....
39.00– 41.99	.....	.....	.....	.....	.....	.....	.....	.....
42.00– 44.99	.....	.....	.....	.....	2	51.8	.....	.....
45.00– 47.99	.....	.....	.....	.....	1	50.0	.....	.....
48.00– 50.99	.....	.....	.....	.....	1	45.0	.....	.....

samples. The number of cottons for each classer which fall within the different ranges of price changes is given in Table 18. For 86 samples classer A found the changes to be less than $18, while B found 114 to be within this range. For A, 35, and for B, 18, fell between $18 and $36. Classer A found that 11 cottons changed more than $36 per bale with a maximum change of $48.63, while B found no cotton changed more than $34.83.

Classer A found that the greatest loss due to cleaning was $20.98, falling within the range of $18-$20.99, as given in Table 18. Classer B found the same cotton gained $2.43, a difference of $23.41 between classers. B found that the greatest loss was $15.64, while for the same cotton A found a loss of only $6.09, a difference of $9.55 between classers. The greatest gain was $38.42 for classer A, and for B this cotton gained $32, a difference of $6.42. For B the greatest gain was $34.83 for which A found a gain of only $22.90, a difference between the classers of $11.93. The greatest difference between the classers for any cotton was $42.46 for a cotton which A thought gained $4.62 by cleaning and B $47.08.

One cotton lost $1.15 by cleaning, according to one classer, and gained $36.41, according to the other classer, a difference of $37.56. In another case, the grower would have gained $23.67 or lost $1.36, according to which classer's classification was used. In 55 cases the differences between the classers in changes in price per bale were between $10 and $42.46, 25 of which were above $20. In only one case did the classers agree on the change in price, a gain of $5.43 per bale, but in 39 cases they differed less than $5 per bale.

With the 2 classers differing so much in their estimates of the effect of cleaning upon the grade and staple of these 132 cottons, it is difficult to draw conclusions from these data as to the probability of the grower profiting by the complete removal of foreign matter, if equipment were available. It seems probable, however, that it would not be profitable to remove foreign matter from cotton which grades SM or better and which contains no more than 5 or 6 percent foreign matter. For cottons of lower grade and with a higher percentage of foreign matter, the removal of waste would probably be profitable.

Other Studies

In a preliminary study of 60 cottons classed by a board of examiners both before and after cleaning, it was found that the removal of foreign matter raised the grade approximately 4 grades. Following the report of this study, Nickerson reported a study of the same problem.

It should be pointed out before comparing results of the 2

studies that the manner of classing used for the Nickerson study differed in one very important point from that employed in the Texas studies. For the cottons included in the Nickerson study the author stated that "paired samples of cleaned and uncleaned lint were prepared in boxes like those used for the cotton standards for grade." This pairing of samples made it possible for the chairman of the Washington Appeal Board of Review Examiners, who classed the cottons, to class the uncleaned along with the cleaned sample. The author points out that "this severe contrast sometimes made it necessary to lower the grade originally given to the ginned lint cotton." Theoretically, in classing each cotton the grade is determined by comparing it with the standards and not with some other cotton.

The classers who classed the cottons for this Texas study had no such opportunity to pair samples or change the grade of one of the pair to conform with the grade of the other. The cleaned and uncleaned samples were coded so that the classers would not be tempted to check one against the other but would presumably check each sample against the standards. These classers were given no information as to the source of the cotton or the method of harvesting used, but all of the cottons were grown in Texas and were those with which they were familiar. They were told, however, that the cleaned samples were the same as the uncleaned, but with the foreign matter removed with a Shirley analyzer. It was thus thought an unbiased report would be obtained, free of any preconceived notions or personal prejudices.

A small number of College Station and Lubbock samples were included in the Nickerson report, making it possible to compare the results of a portion of the 2 studies. Nickerson reported that the grade of College Station hand-picked samples when cleaned were improved an average of 1.5 grades, 2 grades for snapped, slightly over 1 grade for machine-picked and 2 grades for stripped cottons. In the present study, according to classers A and B, respectively, hand-picked samples from College Station were improved 2.4 and 3.8 grades, snapped 2.4 and 4.4, machine-picked 2.0 and 3.8 and stripped 2.4 and 3.8 grades. Differences between the 2 studies for classers A and B are respectively, approximately 1 grade and 2.5 grades for the hand-picked samples, 0.5 and 2.5 grades for snapped, 0.5 and 2.5 for machine-picked, and 0.5 and 2 grades for stripped. Only snapped and stripped cottons from Lubbock were common in both studies. Classer A agreed closely with the average improvement reported by Nickerson, approximately 2 grades. Classer B found improvements of 4.4 and 3.8 for snapped and stripped samples, respectively, a difference of approximately 2 grades from the Nickerson study.

From color measurements of the cottons converted to grade, Nickerson found the improvements in grade for color at Col-

lege Station were for hand-picked 1.5, snapped 2, machine-picked 2 and stripped 2.5 grades. For the present study, classers A and B found that College Station hand-picked samples were improved in color approximately 2 and 3.5 grades, respectively, machine-picked 1.5 and 3.5 grades, snapped 1.5 and 4 grades and stripped 1.5 and 3 grades. It appears that classer A differed from the Nickerson study by only approximately 0.5 grade and classer B from 0.5 to 2 grades for color in the extent of improvement by cleaning.

For the Lubbock snapped and stripped cottons, classer A's estimate of improvement approached that reported in the Nickerson study, but classer B differed by 2.5 grades.

The cottons reported in the Nickerson study were taken from the annual variety studies. They contained less foreign matter than those reported in this study. The cottons used for the Nickerson study were probably most, if not all, ginned on small laboratory gins. Many of those in the present study were ginned on large commercial gins which remove a higher percentage of burs and fine trash than the single-breasted laboratory gin. The differences in ginning and consequent foreign matter may account in part for differences between the 2 studies.

Summary and Conclusions

Samples of 132 cottons representing different varieties, methods of harvesting and locations were classed by 2 classers, both before and after all foreign matter was removed by a Shirley analyzer, to determine, if possible, the effect of foreign matter and its removal upon the grade, staple and price.

The classers were also sent duplicate samples. One checked 3 duplicates out of 5 cottons for grade and 1 of the 5 for staple. The other classer agreed on the duplicates for 3 out of 10 cottons for grade and on 2 for staple.

Classer A found that cleaning improved the grade for leaf 3.3 grades, the color 1.3 grades and the composite grade 2.1 grades. Classer A found that 96 cottons gained and 36 cottons lost in price due to cleaning. The price was increased by cleaning an average of $10.21 for the 132 cottons.

Classer B found that cleaning improved the grade for leaf 4.8 grades, color 3.5 and the composite grade 4.0 grades. Cleaning increased the price per bale of 82 cottons and decreased the price of 50 cottons, according to classer B. The price was increased by cleaning an average of $6.09 per bale.

Measurements of the length of the 264 uncleaned and cleaned samples with the Fibrograph agreed closely with those of classer B. The Fibrograph showed no significant effect upon the aver-

age staple by cleaning. Neither classer found that cleaning significantly changed the average staple, although short-fibered cottons appeared to be slightly longer and long-fibered cottons slightly shorter after cleaning.

Methods of harvesting caused less than 0.5 grade difference in the improvement due to cleaning, according to classer A. Classer B found the greatest difference in improvement between hand-picked and machine-picked cottons, 1.1 grades. B found that machine-picked cotton showed the greatest improvement, although it contained slightly less waste than snapped or stripped cotton.

The effect of location on the improvement due to cleaning varied with the classer. For example, one classer found stripped cottons from College Station were more improved by cleaning than those from Lubbock, while the other classer found the reverse was true.

The 2 classers differed less than 0.5 grade on the average grade of the 132 uncleaned cottons. They agreed on 55 samples but differed from 1 to 2.5 grades for 34 samples.

The 2 classers differed slightly more than 2 grades on the average grade of the 132 cleaned cottons. They differed 2 or more grades for the leaf grade of 82, the color grade of 100 and the composite grade of 82 cleaned cottons.

The classers differed by nearly 3/32 inch in the average staple of the uncleaned and slightly over 2/32 inch for the cleaned samples. Neither classer nor the Fibrograph found that cleaning changed the staple significantly.

The classers differed only $4.12 per bale for the average improvement in price due to cleaning but differed widely for individual cottons. They agreed upon the direction of the change for 95 of the 132 cottons. They differed from $10 to $42 in the extent of change for 55 cottons. Classer A found that 96 cottons gained and 36 lost by cleaning, while B found that 82 gained and 50 lost.

The same cottons which, according to classer B, lost $1.15, $2.30, $0.92, $5.53 and $8.93 per bale by cleaning gained $36.41, $29.20, $22.86, $23.48 and $25.92, respectively, according to classer A. On the other hand, cottons which lost $18.90, $19.11, $1.36, $2.50 and $6.13 per bale, according to the classification of A, would gain $1.34, $0.10, $23.67, $14.50 and $15.85 per bale, respectively, by B's classification. These differences between classers' judgments would cause differences in price per bale for these same cottons of $17 to $38.

The extent to which the classers agreed apparently bore no relationship to the amount of foreign matter in the uncleaned

lint as there were differences greater than $10 for cottons with wastes ranging from approximately 4 to 23 percent.

It is doubtful if the increase in price of relatively clean cotton through the removal of foreign matter would be great enough to compensate for the loss in weight. On the other hand, cotton with much foreign matter, although it loses a good deal of weight by cleaning, is raised enough in grade to materially increase the price. It appears probable, therefore, that cottons with a small amount of foreign matter will not bring more when cleaned, but that cottons with considerable foreign matter can be cleaned profitably.

The frequent wide differences between the 2 classers in their assignment of grade and staple are probably caused by a number of factors. From examination of the uncleaned and cleaned samples, it seems that classer B paid too little attention to the color of the cleaned samples. On the other hand, classer A surely graded the leaf of the cleaned samples too low, for they had practically no visible foreign matter, therefore, might be expected to have an average leaf grade of SGM or better instead of SM+. Classer A apparently staples all cottons shorter than does B. In only 3 of 264 cases (132 uncleaned and 132 cleaned samples) did B assign a shorter staple than A, while in only 26 cases did they agree on the staple.

Classers apparently are more concerned with the area occupied by foreign matter than with the kind and weight of the foreign matter. This study supports the frequent observation that classers tend to ignore color unless a cotton is very obviously tinged or stained.

The results of this study emphasize anew the dependence of the grower on the ability and fairness of the classer. Despite the provision of standards, well-trained, experienced, conscientious, licensed classers are found to differ not only from each other, but to differ from sample to sample of the same cotton.

The prices paid to farmers are based on government standards for grade. The standards used by individual firms and classers frequently are modifications of government standards. The use of different standards, plus inevitable human errors, may result in wide differences between the grades assigned by classers and may mean a material loss to the farmer. Government grade is the chief determinant of price, therefore, it is extremely important that each sample is graded according to actual government standards.

It is recommended that classers use every opportunity to check their grades and staples with each other and with actual physical measurements of the physical properties. It is encouraging to learn that an increasing number of classers are now following this practice, which should result in a more just deal for all concerned with cotton.

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